

APPENDIX E

Regression Analyses of Dioxin TEQ versus Total Aroclors

APPENDIX E

REGRESSION ANALYSES OF DIOXIN TEQ VERSUS TOTAL AROCLORS

As part of the U.S. Environmental Protection Agency's (U.S. EPA's) conditional approval (U.S. EPA, 2010) of the Polychlorinated Biphenyls Notification Plan (PCBNP) (AMEC, 2009), U.S. EPA deferred approval of proposed remediation goals for polychlorinated biphenyls (PCBs) in soil and concrete at the former Pechiney Cast Plate Facility (the Site) until Pechiney could demonstrate that dioxin-like PCB congeners, if present in on-site concrete and/or soil, were not present at more significant concentrations, in terms of potential human health risk, than PCBs as Aroclor mixtures. If potential human health risks were more significant, it was required that Pechiney propose cleanup levels for PCBs in concrete and soil that are adequately protective and do not pose a risk of injury to health or the environment. Based on this requirement, the additional sampling outlined in Section 2.2 of the Sampling and Analysis Plan (SAP) (AMEC, 2010) was conducted in September and October, 2010; the sampling results were evaluated for potential human health concerns; and regression analyses were performed to determine whether or not the proposed risk-based remediation goals for PCBs based on Aroclor mixtures would be adequately protective of PCBs as dioxin-like congeners. The findings of the regression analyses are presented below.

1.0 REGRESSION ANALYSES

Regression analyses were performed with the pairs of dioxin-like PCB congener and Aroclor mixture data to evaluate the potential significance of the relationship between these measurements and determine whether the proposed risk-based remediation goals are adequately protective of potential PCB exposures. Dioxin TEQ and total Aroclor concentrations for the 2010 concrete and soil samples (Tables E-1, E-2, E-3, and E-4) were plotted against each other as representative variables for the dioxin-like PCB congeners and Aroclor mixtures, respectively.

Separate regression analyses were performed for the concrete samples, soil samples, and concrete and soil samples combined. Each regression was made as dioxin TEQ (y-axis) versus total Aroclors (x-axis). For consistency with the treatment of non-detect congeners in the estimation of dioxin TEQ, one half of the reporting limit for non-detect Aroclor mixtures was used in the calculation of total Aroclors, with results for Aroclor-1016, -1232, -1248, -1254, and -1260 factoring into the total Aroclor concentration calculations (i.e., the Aroclor mixtures that were detected at least once in the concrete and soil samples combined).

The data from each sample point were originally plotted by characteristic (i.e., by Phase area and soil sample depth), but no segregation by characteristic was observed. This indicated that there was no basis to perform statistical regressions on separate subsets of concrete or soil samples. Next, linear regressions were performed for the concrete data, soil data, and concrete and soil data combined using the Regression function in Microsoft EXCEL. In these regressions, the line was forced to pass through the origin (the 0,0 point), resulting in a linear equation in the form, $y = mx$, where m is a constant. The 95 percent upper confidence limit (95% UCL) and the 95 percent lower confidence limit (95% LCL) for each regression line were also provided by the Regression function in Microsoft EXCEL, providing upper- and lower-bound estimates, respectively, of the slope (m) of each regression line (i.e., there is less than a 5 percent chance that the true slope of the regression is steeper than the UCL and there is less than a 5 percent chance that the true slope of the regression is less steep than the LCL). The slope of each regression line represents the best estimate of the relationship between dioxin TEQ and total Aroclor concentrations (i.e., the ratio of dioxin TEQ to total Aroclor concentration) for each data set, with the 95% UCL and 95% LCL representing upper- and lower-bound estimates, respectively, of the relationship (ratio) for the data set. These procedures were performed using each data set in an untransformed state (i.e., no logarithmic or other form of transformation was performed on the data prior to the procedures).

The results of the regressions for the untransformed data sets are depicted on Figures E-1, E-2, and E-3 for the concrete data, soil data, and concrete and soil data combined, respectively. As shown in each figure, the results of the regressions were plotted against the proposed risk-based remediation goal for PCBs in concrete and soil that may be left exposed at the surface (upper 5 feet) of 5.3 mg/kg total Aroclors (represented by the black vertical line in each figure), and the equivalent risk-based remediation goal for dioxin-like PCB congeners, 81 pg/g TEQ¹ (represented by the black horizontal line in each figure).

The three regression analyses were repeated using log-transformed data. In this case, the data were transformed using the natural logarithm (symbolized as \ln). The linear regression was performed on the transformed data using the Regression function in Microsoft EXCEL. In these regressions the line was not forced to pass through the origin. The resulting linear equations had the form of $\ln(y) = m/\ln(x)+b$. The 95% UCL and 95% LCL for these linear regressions were calculated using the method described in Schefler (1979). The results of these regressions are depicted on Figures E-4, E-5, and E-6 for the concrete data, soil data, and concrete and soil data combined, respectively. The regressions using log-transformed data estimated two variables, the slope and intercept. Thus, the 95% UCLs and 95% LCLs for these regressions are curved lines. Furthermore, none of the regression lines in the log-transformed domain had

¹ Based on the carcinogenic RBSL for dioxin-like PCB congeners for outdoor commercial/industrial workers (8.1 pg/g TEQ), adjusted to a target cancer risk of 10^{-5} .

a slope that was exactly unity (1.000), which results in curved lines in the non-transformed domain. In this case, neither the regression lines derived from the transformed data nor the corresponding UCLs or LCLs can be used to estimate the ratio of dioxin TEQ to total Aroclor concentration; however, they can be used to calculate a total Aroclor concentration corresponding to a specified dioxin TEQ.²

To compare the relative strength of each regression, the F-statistic for each regression was provided by the Regression function in Microsoft EXCEL. The F-statistic is the ratio of a measure of the goodness of the fit of the regression to the data to a measure of the poorness of the fit. A larger F-statistic corresponds to a better fit of the regression to the data. The resulting F-statistics are provided, along with additional characteristics of each regression, in Table E-5. The F-statistic for each of the six regressions exceeded its respective critical value of F corresponding to a significance of 5% (comparable to 95% confidence). These critical values are the minimum value of the F-statistic needed to achieve a statistical significance of 5%. That all F-statistics exceeded their respective critical values indicates high strength for all of the regressions. The statistical significance of the F-statistics for the six regressions ranged from 2.49×10^{-4} to 3.33×10^{-30} (lower values represent greater strength).

The regression with the strongest F-statistic was the regression using the untransformed combined soil and concrete data. Furthermore, this regression using untransformed data has “physical significance,” in that the slopes of the regression line, the UCL, and the LCL are estimators of the ratio between dioxin TEQ and total Aroclor concentration. As shown on Figure E-3, this regression identifies a concentration of total Aroclors at the risk-based remediation goal equivalent for dioxin TEQ (81 pg/g) that is less than the originally proposed risk-based remediation goal of 5.3 mg/kg for concrete and shallow soil (upper 5 feet). Specifically, the total Aroclor concentrations corresponding to 81 pg/g dioxin TEQ on the regression line, the UCL, and the LCL are 3,540, 3,450, and 3,640 $\mu\text{g}/\text{kg}$ (3.54, 3.45, and 3.64 mg/kg), respectively. As a result, it would appear that a revised risk-based remediation goal for PCBs (as total Aroclors) of 3.5 mg/kg for concrete and soil that may be left exposed at the surface (at a depth interval of 0 to 5 feet bgs) would be adequately protective of PCBs as dioxin-like congeners. To determine if the originally proposed risk-based remediation goal for PCBs (as total Aroclors) in deeper soil of 35 mg/kg would be adequately protective, the results of the regression for the combined soil and concrete data (untransformed) were also plotted against this remediation goal along with the

² The ratio of dioxin TEQ to total Aroclor concentration is the relationship between dioxin TEQ and total Aroclor concentration and should be independent of the magnitude of the total Aroclor concentration (i.e., the ratio should be constant with respect to total Aroclor concentration). That the regressions using log-transformed data yield curved lines in the non-transformed domain means that the regressions using log-transformed data suggest that the ratio varies with total Aroclor concentration, which should not be the case.

equivalent risk-based remediation goal for dioxin-like PCB congeners, 530 pg/g TEQ.³ As shown in Figure E-3, the regression using the combined soil and concrete data (untransformed) identifies a concentration of total Aroclors at the risk-based remediation goal equivalent for dioxin TEQ (530 pg/g) that is less than 35 mg/kg. As a result, it would appear that a revised risk-based remediation goal for PCBs (as total Aroclors) of 23 mg/kg for soil to be left below pavement or other ground cover that only construction workers may come into contact with during construction (or 5 feet below crushed concrete containing less than 3.5 mg/kg) would be adequately protective of PCBs as dioxin-like congeners.

³ Based on the carcinogenic RBSL for dioxin-like PCB congeners for construction workers (53 pg/g TEQ), adjusted to a target cancer risk of 10⁻⁵.

2.0 REFERENCES

AMEC Geomatrix, Inc. (AMEC), 2009, Polychlorinated Biphenyls Notification Plan, Former Pechiney Cast Plate Facility, Vernon, California, July 10.

AMEC, 2010, Sampling and Analysis Plan, Former Pechiney Cast Plate Facility, Vernon, California, July 27.

Scheffler, W.C., 1979, Statistics for the Biological Sciences, 2nd Edition, Addison-Wesley, Reading, MA.

United States Environmental Protection Agency (U.S. EPA), 2010, Polychlorinated Biphenyls – U.S. EPA Conditional Approval Under 40 CFR 761.61(c), Toxic Substances Control Act – “Polychlorinated Biphenyls Notification Plan, Former Pechiney Cast Plate, Inc., Facility, Vernon, California, July 9, 2009,” Letter from Jeff Scott, Director, Waste Management Division, to Donald Thompson, President Pechiney Cast Plate, July 2.

TABLE E-1

POLYCHLORINATED BIPHENYLS IN CONCRETE (SEPTEMBER - OCTOBER 2010)

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Results shown in micrograms per kilogram ($\mu\text{g}/\text{kg}$)

Sample Location	Sample ID	Phase Area	Sample Depth ¹ (Feet)	Sample Date	EPA Method	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total Aroclors (Sum of Detected Aroclors)	Data Source
C-12	C-12-A	I	0	09/15/10	8082	<20 ⁴	<20	<20	<20	110	<20	<20	110	AMEC Geomatix
DC-154	DC-154-A	I	0	09/15/10	8082	<1000	<1000	<1000	<1000	12,000	<1000	1400	13,400	AMEC Geomatix
DC-168	DC-168-C	I	0	09/15/10	8082	<20,000	<20,000	<20,000	<20,000	390,000	<20,000	200,000	590,000	AMEC Geomatix
DC-168	DC-168-A/DC-168-B	I	0	09/15/10	8082	<20,000	<20,000	<20,000	<20,000	160,000	<20,000	40,000	200,000	AMEC Geomatix
DC-205	DC-205-A	I	0	09/14/10	8082	<20	<20	<20	<20	41	<20	31	72	AMEC Geomatix
DC-206	DC-206-A	I	0	09/14/10	8082	<20	<20	<20	<20	50	<20	26	76	AMEC Geomatix
DC-207	DC-207-A	I	0	09/14/10	8082	<1000	<1000	<1000	<1000	2300	<1000	<1000	2300	AMEC Geomatix
DC-208	DC-208-A	I	0	09/14/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	AMEC Geomatix
DC-209	DC-209-A	I	0	09/14/10	8082	<20	<20	<20	<20	20	<20	<20	20	AMEC Geomatix
DC-210	DC-210-A	I	0	09/15/10	8082	<20	<20	<20	<20	29	<20	<20	29	AMEC Geomatix
DC-211	DC-211-A	I	0	09/14/10	8082	<100	<100	<100	<100	1400	<100	780	2180	AMEC Geomatix
DC-212	DC-212-A	I	0	09/14/10	8082	<20	<20	<20	<20	43	<20	<20	43	AMEC Geomatix
DC-213	DC-213-A	I	0	09/15/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	AMEC Geomatix
DC-214	DC-214-A1	I	0	09/14/10	8082	<20	<20	<20	<20	220	<20	43	263	AMEC Geomatix
DC-215	DC-215-A	I	0	09/14/10	8082	<20	<20	<20	<20	140	<20	31	171	AMEC Geomatix
DC-216	DC-216-A	I	0	09/15/10	8082	<200	<200	<200	<200	1900	<200	720	2620	AMEC Geomatix
DC-217	DC-217-A	I	0	09/13/10	8082	<20	<20	<20	<20	<20	230	130	360	AMEC Geomatix
DC-218	DC-218-A	I	0	09/13/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	AMEC Geomatix
DC-263	DC-263-A	I	0	10/15/10	8082	<100	<100	<100	<100	1000	<100	120	1120	AMEC Geomatix
DC-264	DC-264-A	I	0	10/15/10	8082	<400	<400	<400	<400	3800	5400	2200	11,400	AMEC Geomatix
DC-265	DC-265-A	I	0	10/15/10	8082	<200	<200	<200	<200	380	690	340	1410	AMEC Geomatix
DC-266	DC-266-A	I	0	10/15/10	8082	<400	<400	<400	<400	4100	5800	2200	12,100	AMEC Geomatix
DC-267	DC-267-A	I	0	10/18/10	8082	<200	<200	<200	<200	770	<200	370	1140	AMEC Geomatix
DC-268	DC-268-A	I	0	10/18/10	8082	<200	<200	<200	<200	540	<200	200	740	AMEC Geomatix
DC-269	DC-269-A	I	0	10/18/10	8082	<20	<20	<20	<20	34	<20	24	58	AMEC Geomatix
DC-270	DC-270-A	I	0	10/18/10	8082	<200	<200	<200	<200	1000	2700	1000	4700	AMEC Geomatix
DC-271	DC-271-A	I	0	10/18/10	8082	<200	<200	<200	<200	310	<200	<200	310	AMEC Geomatix
DC-272	DC-272-A	I	0	10/18/10	8082	<200	<200	<200	<200	650	<200	<200	650	AMEC Geomatix
DC-273	DC-273-A	I	0	10/18/10	8082	<200	<200	<200	<200	420	<200	<200	420	AMEC Geomatix
DC-274	DC-274-A	I	0	10/18/10	8082	<200	<200	<200	<200	460	<200	<200	460	AMEC Geomatix
DC-275	DC-275-A	I	0	10/18/10	8082	<200	<200	<200	<200	1300	<200	440	1740	AMEC Geomatix

TABLE E-1

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Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Results shown in micrograms per kilogram ($\mu\text{g}/\text{kg}$)

Sample Location	Sample ID	Phase Area	Sample Depth ¹ (Feet)	Sample Date	EPA Method	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total Aroclors (Sum of Detected Aroclors)	Data Source
DC-276	DC-276-A	I	0	10/18/10	8082	<20,000	<20,000	<20,000	<20,000	99,000	<20,000	<20,000	99,000	AMEC Geomatrix
C-14	C-14-A	IIA/IIB	0	09/15/10	8082	<20	<20	<20	<20	38	<20	74	112	AMEC Geomatrix
DC-22	DC-22-A	IIA/IIB	0	09/15/10	8082	<20	<20	<20	<20	39	<20	130	169	AMEC Geomatrix
DC-23	DC-23-A	IIA/IIB	0	09/15/10	8082	<20	<20	<20	<20	370	<20	810	1180	AMEC Geomatrix
DC-52	DC-52-A	IIA/IIB	0	09/15/10	8082	<20	<20	<20	<20	41	<20	33	74	AMEC Geomatrix
DC-219	DC-219-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	38	<20	<20	38	AMEC Geomatrix
DC-220	DC-220-A	IIA/IIB	0	09/14/10	8082	<20	<20	<20	<20	97	100	96	293	AMEC Geomatrix
DC-221	DC-221-A	IIA/IIB	0	09/14/10	8082	<20	<20	<20	<20	97	<20	61	158	AMEC Geomatrix
DC-222	DC-222-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	22	<20	29	51	AMEC Geomatrix
DC-223	DC-223-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	1300	<20	96	1396	AMEC Geomatrix
DC-224	DC-224-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	<20	<20	20	20	AMEC Geomatrix
DC-225	DC-225-A	IIA/IIB	0	09/10/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	AMEC Geomatrix
DC-226	DC-226-A1	IIA/IIB	0	09/10/10	8082	<20	<20	<20	<20	<20	<20	28	28	AMEC Geomatrix
DC-227	DC-227-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	<20	260	150	410	AMEC Geomatrix
DC-228	DC-228-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	AMEC Geomatrix
DC-229	DC-229-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	39	<20	50	89	AMEC Geomatrix
DC-230	DC-230-A	IIA/IIB	0	09/10/10	8082	26	<20	<20	<20	36	<20	42	104	AMEC Geomatrix
DC-231	DC-231-A	IIA/IIB	0	09/10/10	8082	<20	<20	<20	<20	20	<20	20	40	AMEC Geomatrix
DC-236	DC-236-A	IIA/IIB	0	09/10/10	8082	<20	<20	<20	<20	<20	<20	24	24	AMEC Geomatrix
DC-246	DC-246-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	<20	57	39	96	AMEC Geomatrix
DC-247	DC-247-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	28	<20	62	90	AMEC Geomatrix
DC-248	DC-248-A	IIA/IIB	0	09/13/10	8082	<1000	<1000	<1000	<1000	65,000	<1000	2800	67,800	AMEC Geomatrix
DC-249	DC-249-A1	IIA/IIB	0	09/15/10	8082	<20	<20	<20	<20	45	<20	<20	45	AMEC Geomatrix
DC-250	DC-250-A	IIA/IIB	0	09/14/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	AMEC Geomatrix
DC-251	DC-251-A	IIA/IIB	0	09/14/10	8082	<20	<20	<20	<20	77	<20	45	122	AMEC Geomatrix
DC-252	DC-252-A	IIA/IIB	0	09/14/10	8082	<20	<20	<20	<20	44	<20	20	64	AMEC Geomatrix
DC-253	DC-253-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	<20	<20	25	25	AMEC Geomatrix
DC-254	DC-254-A	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	40	<20	<20	40	AMEC Geomatrix
DC-255	DC-255-A	IIA/IIB	0	10/15/10	8082	<200	<200	<200	<200	1600	<200	150	1750	AMEC Geomatrix
DC-256	DC-256-A	IIA/IIB	0	10/15/10	8082	<20	<20	<20	<20	310	<20	72	382	AMEC Geomatrix
DC-257	DC-257-A	IIA/IIB	0	10/15/10	8082	<40	<40	<40	<40	210	<40	61	271	AMEC Geomatrix

TABLE E-1

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Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Results shown in micrograms per kilogram ($\mu\text{g}/\text{kg}$)

Sample Location	Sample ID	Phase Area	Sample Depth ¹ (Feet)	Sample Date	EPA Method	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total Aroclors (Sum of Detected Aroclors)	Data Source
DC-258	DC-258-A	IIA/IIB	0	10/15/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	AMEC Geomatrix
DC-259	DC-259-A	IIA/IIB	0	10/15/10	8082	<20	<20	<20	<20	24	<20	61	85	AMEC Geomatrix
DC-260	DC-260-A	IIA/IIB	0	10/15/10	8082	<200	<200	<200	<200	1800	<200	<200	1800	AMEC Geomatrix
DC-261	DC-261-A	IIA/IIB	0	10/15/10	8082	<20	<20	<20	<20	56	<20	<20	56	AMEC Geomatrix
DC-262	DC-262-A	IIA/IIB	0	10/15/10	8082	<200	<200	<200	<200	280	<200	<200	280	AMEC Geomatrix
B-1	B-1-A1	IV	0	09/15/10	8082	<20	<20	<20	<20	320	<20	280	600	AMEC Geomatrix
DC-25	DC-25-A	IV	0	09/15/10	8082	<20	<20	<20	<20	<20	<20	28	28	AMEC Geomatrix
DC-232	DC-232-A	IV	0	09/10/10	8082	<20	<20	<20	<20	<20	1000	<20	1000	AMEC Geomatrix
DC-233	DC-233-A	IV	0	09/10/10	8082	<20	<20	<20	<20	53	<20	260	313	AMEC Geomatrix
DC-234	DC-234-A	IV	0	09/09/10	8082	<20	<20	<20	<20	<20	<20	40	40	AMEC Geomatrix
DC-235	DC-235-A	IV	0	09/10/10	8082	320	<200	<200	<200	<200	<200	210	530	AMEC Geomatrix
DC-237	DC-237-A	IV	0	09/09/10	8082	<20	<20	<20	<20	<20	<20	86	86	AMEC Geomatrix
DC-238	DC-238-A	IV	0	09/09/10	8082	<20	<20	<20	<20	<20	<20	40	40	AMEC Geomatrix
DC-239	DC-239-A	IV	0	09/09/10	8082	27	<20	<20	<20	<20	<20	65	92	AMEC Geomatrix
DC-240	DC-240-A	IV	0	09/09/10	8082	<200	<200	<200	<200	<200	<200	<200	<200	AMEC Geomatrix
DC-241	DC-241-A	IV	0	09/09/10	8082	<20	<20	<20	<20	<20	<20	20	20	AMEC Geomatrix
DC-242	DC-242-A	IV	0	09/09/10	8082	<20	<20	<20	<20	<20	<20	24	24	AMEC Geomatrix
DC-243	DC-243-A	IV	0	09/09/10	8082	<20	<20	<20	<20	<20	<20	23	23	AMEC Geomatrix
DC-244	DC-244-A	IV	0	09/09/10	8082	41	<20	<20	<20	58	<20	82	181	AMEC Geomatrix
DC-245	DC-245-A	IV	0	09/10/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	AMEC Geomatrix

Notes:

1. Depth = top of sample depth measured in feet below ground surface.
2. < = not detected at or above the reporting limit shown.

Data Source:

AMEC Geomatrix = "B", "C", and "DC" concrete samples collected during PCB characterization and verification sampling.

TABLE E-2

POLYCHLORINATED BIPHENYLS IN SOIL (SEPTEMBER - OCTOBER 2010)

Former Pechiney Cast Plate, Inc. Facility

Vernon, California

Results shown in micrograms per kilogram ($\mu\text{g}/\text{kg}$)

Sample	Phase Area	Sample Depth ¹	Sample Date	EPA Method	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total Aroclors (Sum of Detected Aroclors)	Excavated Status ²	Data Source
Industrial PRGs					21,246	NE ³	NE	NE	NE	744	NE	NE	--	--
184-SS-01	I	1.7	09/13/10	8082	<20 ⁴	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
185-SS-01	I	2.4	09/13/10	8082	<20	<20	<20	190	<20	<20	<20	190	--	AMEC Geomatrix
187-SS-01	I	1.8	09/14/10	8082	<20	<20	<20	47	<20	51	98	--	AMEC Geomatrix	
190-SS-01	I	0.9	09/24/10	8082	<20	<20	<20	80	<20	<20	80	--	AMEC Geomatrix	
191-SS-01	I	1.0	09/24/10	8082	<1000	<1000	<1000	<1000	11,000	<1000	<1000	11,000	--	AMEC Geomatrix
192-SS-01	I	0.9	09/24/10	8082	<20	<20	<20	23	<20	<20	23	--	AMEC Geomatrix	
193-SS-01	I	1.0	09/24/10	8082	<100,000	<100,000	<100,000	<100,000	1,000,000	<100,000	<100,000	1,000,000	--	AMEC Geomatrix
194-SS-01	I	0.9	09/24/10	8082	<400	<400	<400	450	<400	<400	<400	450	--	AMEC Geomatrix
195-SS-01	I	0.9	09/24/10	8082	<10,000	<10,000	<10,000	<10,000	94,000	<10,000	<10,000	94,000	--	AMEC Geomatrix
196-SS-01	I	0.8	09/24/10	8082	<20	<20	<20	730	<20	150	880	--	AMEC Geomatrix	
197-SS-01	I	0.9	09/24/10	8082	<100	<100	<100	390	<100	<100	390	--	AMEC Geomatrix	
198-SS-01	I	0.9	09/24/10	8082	<40	<40	<40	190	<40	<40	190	--	AMEC Geomatrix	
199-SS-01	I	0.9	09/24/10	8082	<40	<40	<40	160	<40	110	270	--	AMEC Geomatrix	
200-SS-01	I	1.0	09/24/10	8082	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix	
201-SS-01	I	1.0	09/24/10	8082	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix	
202-SS-01	I	1.2	09/24/10	8082	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix	
203-SS-01	I	1.1	09/24/10	8082	250	<40	<40	<40	<40	<40	<40	250	--	AMEC Geomatrix
204-SS-01	I	0.9	09/24/10	8082	<200	<200	<200	<200	1800	<200	<200	1800	--	AMEC Geomatrix
205-SS-01	I	0.9	09/24/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
206-SS-01	I	0.9	09/24/10	8082	<200	<200	<200	<200	1100	<200	<200	1100	--	AMEC Geomatrix
208-SS-01	I	1.2	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
209-SS-01	I	1.2	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
210-SS-01	I	1.1	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
211-SS-01	I	1.8	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
212-SS-01	I	1.2	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
213-SS-01	I	1.0	09/24/10	8082	<100	<100	<100	<100	240	<100	<100	240	--	AMEC Geomatrix
214-SS-01	I	0.9	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
215-SS-01	I	1.1	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
216-SS-01	I	1.2	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
217-SS-01	I	1.2	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
218-SS-01	I	1.2	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
219-SS-01	I	1.2	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
220-SS-01	I	1.2	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
178-SS-01	IIA/IIB	0	09/13/10	8082	<20	<20	<20	<20	270	<20	180	450	--	AMEC Geomatrix
181-SS-01	IIA/IIB	5.7	09/13/10	8082	<20	<20	<20	<20	54	56	30	140	--	AMEC Geomatrix
182-SS-01	IIA/IIB	5.7	09/13/10	8082	<1000	<1000	<1000	<1000	14,000	19,000	26,000	59,000	--	AMEC Geomatrix

TABLE E-2

POLYCHLORINATED BIPHENYLS IN SOIL (SEPTEMBER - OCTOBER 2010)

Former Pechiney Cast Plate, Inc. Facility

Vernon, California

Results shown in micrograms per kilogram ($\mu\text{g}/\text{kg}$)

Sample	Phase Area	Sample Depth ¹	Sample Date	EPA Method	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total Aroclors (Sum of Detected Aroclors)	Excavated Status ²	Data Source
Industrial PRGs					21,246	NE ³	NE	NE	NE	744	NE	NE	--	--
188-SS-01	IIA/IIB	2.3	09/13/10	8082	38	<20	<20	<20	<20	<20	<20	38	--	AMEC Geomatrix
189-SS-01	IIA/IIB	4.7	09/14/10	8082	<20	<20	610	<20	<20	<20	<20	610	--	AMEC Geomatrix
189-SS-02	IIA/IIB	9.7	09/14/10	8082	<100	<100	<100	<100	1400	<100	<100	1400	--	AMEC Geomatrix
221-SS-01	IIA/IIB	0.8	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
222-SS-01	IIA/IIB	0.7	09/23/10	8082	<20	<20	<20	<20	<20	84	<20	84	--	AMEC Geomatrix
223-SS-01	IIA/IIB	1.2	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
224-SS-01	IIA/IIB	0.7	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
225-SS-01	IIA/IIB	0.7	09/23/10	8082	<20	<20	<20	<20	<20	<20	<20	<20	--	AMEC Geomatrix
226-SS-01	IIA/IIB	0.7	09/23/10	8082	<20	<20	<20	<20	120	<20	<20	120	--	AMEC Geomatrix
227-SS-01	IIA/IIB	0.8	09/23/10	8082	<20	<20	<20	<20	<20	150	<20	150	--	AMEC Geomatrix
228-SS-01	IIA/IIB	0.7	09/23/10	8082	<100	<100	<100	<100	3200	<100	610	3810	--	AMEC Geomatrix
229-SS-01	IIA/IIB	1.0	09/23/10	8082	<10,000	<10,000	<10,000	<10,000	610,000	<10,000	22,000	632,000	--	AMEC Geomatrix
230-SS-01	IIA/IIB	0.9	09/24/10	8082	<10,000	<10,000	<10,000	<10,000	1,500,000	<10,000	40,000	1,540,000	--	AMEC Geomatrix
231-SS-01	IIA/IIB	0.8	09/24/10	8082	<10,000	<10,000	<10,000	<10,000	1,500,000	<10,000	60,000	1,560,000	--	AMEC Geomatrix
232-SS-01	IIA/IIB	0.9	09/24/10	8082	<4000	<4000	<4000	<4000	31,000	<4000	<4000	31,000	--	AMEC Geomatrix
233-SS-01	IIA/IIB	0.8	09/24/10	8082	<10,000	<10,000	<10,000	<10,000	1,900,000	<10,000	55,000	1,955,000	--	AMEC Geomatrix
234-SS-01	IIA/IIB	0.9	09/24/10	8082	<20	<20	<20	<20	250	<20	<20	250	--	AMEC Geomatrix
235-SS-01	IIA/IIB	1.0	09/24/10	8082	<20	<20	<20	<20	230	<20	<20	230	--	AMEC Geomatrix
236-SS-01	IIA/IIB	0.8	09/24/10	8082	<10,000	<10,000	<10,000	<10,000	1,100,000	<10,000	23,000	1,123,000	--	AMEC Geomatrix
237-SS-01	IIA/IIB	0.7	09/24/10	8082	<20	<20	<20	<20	220	<20	<20	220	--	AMEC Geomatrix
238-SS-01	IIA/IIB	0.8	09/24/10	8082	<100	<100	<100	<100	660	<100	<100	660	--	AMEC Geomatrix
175-SS-01	IIIA	2.7	09/13/10	8082	<20	<20	<20	<20	3400	<20	500	3900	--	AMEC Geomatrix
175-SS-01 ⁵	IIIA	2.7	09/13/10	8082	<200	<200	<200	<200	3500	3900	720	8120	--	AMEC Geomatrix
175-SS-01 ⁵	IIIA	2.7	09/13/10	8082	<200	<200	<200	<200	3900	3900	780	8580	--	AMEC Geomatrix
176-SS-01	IIIA	4.5	09/14/10	8082	<100	<100	<100	<100	20,000	<100	860	20,860	--	AMEC Geomatrix
177-SS-01	IIIA	4.5	09/14/10	8082	<20	<20	<20	<20	130	<20	<20	130	--	AMEC Geomatrix
180-SS-01	IIIA	4.5	09/14/10	8082	<20	<20	<20	<20	65	<20	26	91	--	AMEC Geomatrix
180-SS-02	IIIA	9.5	09/14/10	8082	<20	<20	<20	<20	160	<20	<20	160	--	AMEC Geomatrix
179-SS-01	IV	0.8	09/13/10	8082	<100	<100	<100	<100	130	<100	340	470	--	AMEC Geomatrix
183-SS-01	IV	0.8	09/13/10	8082	<20	<20	<20	<20	680	2300	350	3330	--	AMEC Geomatrix
183-SS-01 ⁵	IV	0.8	09/13/10	8082	<200	<200	<200	<200	680	2000	380	3060	--	AMEC Geomatrix
183-SS-01 ⁵	IV	0.8	09/13/10	8082	<200	<200	<200	<200	650	2200	410	3260	--	AMEC Geomatrix
186-SS-01	VI	2.0	09/14/10	8082	<20	<20	<20	<20	20	<20	<20	<20	--	AMEC Geomatrix

Notes:

1. Depth = top of sample depth measured in feet below ground surface.
2. Samples which have been previously excavated are listed "excavated".
3. NE = not established.
4. < = not detected at or above the reporting limit shown.
5. Samples were reanalyzed to verify concentrations of PCB aroclors in primary samples. Samples were analyzed past the EPA-recommended hold time.

Data Source:

AMEC Geomatrix = soil samples collected during additional PCB sampling outlined in the Sampling and Analysis Plan.

TABLE E-3

DIOXIN-LIKE POLYCHLORINATED BIPHENYL (PCB) CONGENERS AND DIOXIN TEQs IN CONCRETE

Former Pechiney Cast Plate, Inc., Facility

Vernon, California

Concentrations reported in picograms per gram (pg/g)

Sample Location	Sample ID	Phase Area	Sample Depth ¹	Sample Date	PCB 77	PCB 81	PCB 105	PCB 114	PCB 118	PCB 123	PCB 126	PCB 156, 157	PCB 167	PCB 169	PCB 189	Dioxin TEQ ²
				WHO 2005 TEF ³	0.0001	0.0003	0.00003	0.00003	0.00003	0.00003	0.1	0.00003	0.00003	0.03	0.00003	-- ⁴
C-12	C-12-A	I	0	09/15/10	190 J	<11.7 ⁵ UJ	825	<45.5	1440	<39.5	<52.6	143	49.0	<15.9	19.9	2.96
DC-154	DC-154-A	I	0	09/15/10	119,000	4660	457,000	28,900	703,000	11,500	5960	44,700	13,200	<564	2630	656
DC-168	DC-168-C	I	0	09/15/10	2,730,000	164,000 J	10,500,000	842,000	18,100,000 J,E	560,000	124,000	1,530,000	509,000	<37,214	302,000	14,250
C-14	C-14-A	IIA/IIB	0	09/15/10	131 J	<29.2 UJ	420 J	<72.4	920 J	<59.9 UJ	<100 UJ	242	98.6	<53.3	45.6	5.87
DC-22	DC-22-A	IIA/IIB	0	09/15/10	1010	<413	3310	<440	7990	405	<339	1300	1020	238	535	24.7
DC-23	DC-23-A	IIA/IIB	0	09/15/10	4060	<1546	13,900	<1109	26,200	<1135	<842 UJ	4340	2740	<536	1030	52.3
DC-52	DC-52-A	IIA/IIB	0	09/15/10	659 J	<59.3 UJ	2220	99.3	2990	104	<82.4	216	136	<50.5	41.7	5.13
B-1	B-1-A4 ⁶	IV	0	09/15/10	4600	<2171	14,600	<1746	25,200 J	<1546	<1647	1700	<1000	<677	<581	94.6
DC-25	DC-25-A	IV	0	09/15/10	77.9 J	<32.6 UJ	260	<46.8	389	<39.3	<45.1	<46.6	58.0	<34.8	28.5	2.81

Notes:

1. Depth = top of sample depth measured in feet below ground surface.
2. TEQ = Toxic Equivalent. Dioxin TEQ concentrations are calculated as the sum of the concentration of each dioxin-like PCB congener times the congener-specific toxic equivalency factor (TEF). The dioxin-like PCB congener concentrations in concrete and TEFs are listed above. Results below the reporting limit are represented by a value of one half the reporting limit in the dioxin TEQ concentration calculations.
3. WHO 2005 TEF = World Health Organization toxicity equivalency factors (TEF), released in 2005, but published in 2006 by Van den Berg, M. et al. ("The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds," *Toxicological Sciences*, 93[2]: 223-241, October).
4. -- = not applicable.
5. < = not detected at or above the reporting limit shown.
6. Samples B-1-A1, B-1-A4, and B-1-A5 were collected from the same area. Of the three samples, sample B-1-A4 was selected by SGS for analysis of PCB congeners.

Qualifiers:

E = concentration detected is greater than the upper calibration limit

J = estimated value

UJ = indicates the compound was analyzed but not detected and the sample detection limit is an estimated value.

TABLE E-4

DIOXIN-LIKE POLYCHLORINATED BIPHENYL (PCB) CONGENERS AND DIOXIN TEQs IN SOIL

Former Pechiney Cast Plate, Inc. Facility

Vernon, California

Concentrations reported in picograms per gram (pg/g)

Sample Location	Sample ID	Phase Area	Sample Depth ¹	Sample Date	PCB 77	PCB 81	PCB 105	PCB 114	PCB 118	PCB 123	PCB 126	PCB 156, 157	PCB 167	PCB 169	PCB 189	Dioxin TEQ ²
				WHO 2005 TEF ³	0.0001	0.0003	0.00003	0.00003	0.00003	0.1	0.00003	0.00003	0.03	0.00003	-- ⁴	
#184	184-SS-01	I	1.7	09/13/10	4.18	<2.37 ⁵	36.6	<4.33	75.4 J	<3.59	<4.44	28.2	9.91	<4.28	2.82	0.29
#185	185-SS-01	I	2.4	09/13/10	5.74	<5.18	40.2	5.85	176 J	5.74	<2.72	6.58	<2.77	<2.39	1.25	0.18
#187	187-SS-01	I	1.8	09/14/10	<60.1	<55.0	2200 J	<216	2740 J	<227 UJ	<306 UJ	4760	1540	<139	176	17.7
#178	178-SS-01	IIA/IIB	0	09/13/10	11,900	<698	44,200 J,E	1060	75,200 J,E	8030	<925	7250	2450	<216	487	54.9
#181	181-SS-01	IIA/IIB	5.7	09/13/10	959	43.3	3620 J,E	253	5950 J,E	141	61.0	597	191	9.68	66.7	6.82
#182	182-SS-01	IIA/IIB	5.7	09/13/10	131,000 J,E	<15,391	565,000 J,E	25,400	1,030,000 J,E	22,400	<8373	157,000 J,E	56,300 J,E	<5493	23,100	573
#188	188-SS-01	IIA/IIB	2.3	09/13/10	26.5	<2.60	99.0	6.87	156 J	4.03	<2.16	7.68	2.73	<1.09	<1.12	0.14
#189	189-SS-01	IIA/IIB	4.7	09/14/10	41.9	<10.7	94.0	<8.38	198 J	<6.87	<8.89	8.55	<3.44	<3.30	<2.00	0.51
#189	189-SS-02	IIA/IIB	9.7	09/14/10	690	<87.7	33,900 J,E	1170	31,800 J,E	1040	<47.6	931	169	<11.5	6.57	4.71
#175	175-SS-01	IIIA	2.7	09/13/10	51,500	3130	246,000 J,E	18,700	320,000 J,E	7200	3450	20,900	5760	252	1210	377
#176	176-SS-01	IIIA	4.5	09/14/10	102,000 J,E	4230	322,000 J,E	23,000	446,000 J,E	13,400	3090	22,000	6090	103	937	349
#177	177-SS-01	IIIA	4.5	09/14/10	4080 J,E	<112	9320 J,E	503	14,200 J,E	368	85.5	464	127	<4.26	17.4	9.79
#180	180-SS-01	IIIA	4.5	09/14/10	1020	39.5	3570 J,E	232	6250 J,E	117	79.1 J	644	163	<11.4	36.1	8.53
#180	180-SS-02	IIIA	9.5	09/14/10	382	16.4	1140	84.1	2150 J	50.4	17.1	128	37.3	<2.64	6.30	1.90
#179	179-SS-01	IV	0.8	09/13/10	<1984	<1837	4220	<1834	6710	<1630	<1716	<1470	<1316	<1296	<967	106
#183	183-SS-01	IV	0.8	09/13/10	32,200 J,E	1160	111,000 J,E	6490	169,000 J,E	4620	1140	8740	2310	49.2	516	128
#186	186-SS-01	VI	2.0	09/14/10	15.4	<4.97	40.4 J	<4.58	60.9 J	<4.31	<4.32	5.27	1.97	<1.58	<1.17	0.25

Notes:

1. Depth = top of sample depth measured in feet below ground surface.
2. TEQ = Toxic Equivalent. Dioxin TEQ concentrations are calculated as the sum of the concentration of each dioxin-like PCB congener times the congener-specific toxic equivalency factor (TEF). The dioxin-like PCB congener concentrations in soil and TEFs are listed above. Results below the reporting limit are represented by a value of one half the reporting limit in the dioxin TEQ concentration calculations.
3. WHO 2005 TEF = World Health Organization toxicity equivalency factors (TEF), released in 2005, but published in 2006 by Van den Berg, M. et al. ("The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds," Toxicological Sciences, 93[2]: 223-241, October).
4. -- = not applicable.
5. < = not detected at or above the reporting limit shown.

Qualifiers:

E = concentration detected is greater than the upper calibration limit

J = estimated value

UJ = indicates the compound was analyzed but not detected and the sample detection limit is an estimated value.

TABLE E-5

DIOXIN TEQ VS. TOTAL PCBs (AS AROCLORS)

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Regression	Number of Data Points	Slope of Regression Line	Intercept of Regression Line	Ratio of Dioxin TEQ to Total Aroclor Concentration (pg/g)/(μg/kg)			Total Aroclor Concentration Corresponding to 81 pg/g Dioxin TEQ ⁴			F-Statistic	Critical Value of F for α = 0.05	Statistical Significance of F-Statistic ⁵
				95% UCL	Regression	95% LCL	95% UCL	Regression	95% LCL			
Untransformed Data												
Concrete	9	0.0230 ¹	0	0.0234	0.0230	0.0226	3,460	3,520	3,590	15437	5.32	5.77 × 10 ⁻¹³
Soil	17	0.0107 ¹	0	0.014	0.0107	0.00748	5,800	7,500	10,800	48.8	4.49	4.40 × 10 ⁻⁶
Combined Soil and Concrete	26	0.0229 ¹	0	0.0235	0.0229	0.0223	3,450	3,540	3,640	5874	4.24	3.33 × 10 ⁻³⁰
Log-Transformed Data												
Concrete	9	0.933 ²	-2.59 ³	NA	NA	NA	1,110	1,770	2,960	132	5.59	8.56 × 10 ⁻⁶
Soil	17	1.08 ²	-4.62 ³	NA	NA	NA	1,850	4,380	20,100	22.9	4.54	2.49 × 10 ⁻⁴
Combined Soil and Concrete	26	1.03 ²	-3.92 ³	NA	NA	NA	1,870	3,350	7,270	56.4	4.26	9.48 × 10 ⁻⁸

Notes:

1. Slope of the regression line has the units picograms per gram per microgram per kilogram ([pg/g][μg/kg]).
2. Slope of the regression line in the log-transformed domain (dimensionless).
3. Intercept of the regression line in the log-transformed domain (dimensionless).
4. Concentration in micrograms per kilogram (μg/kg).
5. Smaller values of the statistical significance correspond to greater strength for the regression.

Abbreviation:

NA = not applicable. The ratio of dioxin TEQ to total Aroclors cannot be estimated using a regression of log-transformed data.











